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Clinical Article

Ruptured intracranial dissecting aneurysms: management considerations with a focus on surgical and endovascular techniques to preserve arterial continuity

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Summary

Background. The present retrospective analysis was undertaken to review an institutional experience with 13 intracranial dissecting aneurysms as source of subarachnoid haemorrhage (SAH) among a total of 585 ruptured intracranial aneurysms.

Methods and results. In 6 patients the vertebral artery (VA) was affected, in 2 patients the basilar artery (BA), in 3 the internal carotid (ICA), in 1 the middle cerebral (MCA) and in 1 the postcommunicating (A2) segment of the anterior cerebral artery (ACA). Maintaining arterial patency was aimed at in all patients. Tangential clipping or circumferential wrapping were used as surgical methods. Endovascular stenting and/or coiling was applied in 2 instances. Four of the 6 VA dissecting aneurysms underwent surgical exploration between 1 and 22 days after haemorrhage. Two patients were in WFNS grade V and died subsequently with the aneurysms untreated, one after rehaemorrhage. In the patients with secured VA aneurysms the postoperative course was uncomplicated with the exception of additional caudal cranial nerve injury in 1 instance. Both BA aneurysms were initially treated by endovascular methods. In the first patient incomplete packing with Gugliemi detachable (GDC) coils was achieved. Follow-up angiography 6 months later showed growth and coil compaction and subsequent wrapping with Teflon fibres resulting in angiographic stabilization. The other BA aneurysm was treated by a combination of a coronary stent and GDC coils. The 3 dissecting ICA aneurysms were all explored surgically. In only 1 instance ICA continuity could be preserved by wrapping, in the other 2 cases a major portion of the vessel wall disintegrated upon removal of the surrounding clot. The only ACA dissecting aneurysm, on A2, was successfully treated with a Dacron cuff. In the single patient with a MCA aneurysm, a decision for conservative management was taken, because neither a surgical nor an endovascular solution was seen as a possibility that did not risk occlusion of lenticulostriate branches. The patient suffered a fatal rehaemorrhage 4 weeks later at her home.

Conclusions. The reported experience suggests that in Western countries also dissecting aneurysms are an occasional source of SAH. The outcome in our conservatively managed patients confirms the poor prognosis of conservative management. Wrapping and endovascular stent based methods can achieve stabilization of the dissected artery without sacrificing the artery. Results of treatment appear to depend largely on the location of the dissecting aneurysm.

Keywords: Dissecting intracranial aneurysm; natural history; stent; subarachnoid haemorrhage; wrapping.

Introduction

Subarachnoid haemorrhage from ruptured intracranial dissecting aneurysms is known mainly from Japanese publications and seems to affect primarily the vertebral arteries [19, 21, 38, 54, 60]. The natural history of ruptured dissecting aneurysm is ill defined but there is growing evidence that the risk of early rehaemorrhage compares to the risk of ruptured saccular aneurysms. In the series of Mizutani and co-workers subsequent rupture occurred in 30(71.4%) of 42 patients [36]. Excluding one patient with postoperative rupture, 29 patients suffered a subsequent rupture in the unsecured stage. Of these 29 patients, 19 were operated on after the subsequent rupture and 10 were not operated on because of deteriorated clinical conditions (9 patients) or anatomical considerations (1 patient). Of the 30 patients that suffered a subsequent rupture, 14 died. Twelve of the deaths were directly related to the second episode of rupture. Diagnosis of vertebral artery dissecting aneurysms is classically based primarily on the angiographic pearl-and-string sign, dilatation of the lumen adjacent to a stenotic segment. Treatment of vertebral artery dissecting aneurysms involves traditionally trapping of the diseased artery. More recently, reports of ruptured intracranial dissecting aneurysms in nonvertebral locations appeared in the literature. It appears that the diagnostic key, the pearl-and-string sign is attenuated in other locations so that it may not be recognizable [15, 21]. Furthermore, trapping cannot be considered as a first line option for nonvertebral locations. Applying strict diagnostic criteria we observed 13 ruptured dissecting aneurysms among a series of 585 ruptured intracranial aneurysms treated between 1994 and 2001. Only a minority was located at the classical vertebral position. The purpose of the present report is to illustrate general diagnostic criteria and the methods developed for repair of dissecting aneurysms with preservation of the arterial continuity.

Clinical material and methods

SAH management

Between 1994 and 2001, 585 ruptured intracranial aneurysms were treated by our group. The general management of patients with aneurysmal subarachnoid haemorrhage has been described before [56, 57]. In short, early transfer and stabilization, ventriculostomy and tirilazad mesylate for WFNS grades IV and V, ventilation for GCS below 11, early angiography and securing of aneurysm for grade I–IV cases, intravenous followed by oral nimodipine and daily transcranial Doppler (TCD) monitoring [11, 18, 26, 27].

Identification of dissecting aneurysms

Identification of dissecting aneurysms was based primarily on angiographic criteria. A biplane digital subtraction unit with a resolution of 1024 pixels was used after April 1996 (Siemens, Erlangen, Germany). Before that time a single plane 512-pixel system was available (Siemens). A clear-cut pearl-and-string sign or identification of a false lumen were accepted as definite prove of the dissecting nature of the aneurysm. Atypical aneurysmal configurations at nonbranching sites alone were not accepted as criteria. Such aneurysms were only included in the present series if the intraoperative view showed an arterial dissection extending beyond the dilated segment. These restrictive criteria possibly exclude dissecting aneurysms undergoing delayed angiography and surgery. In these situations it may not be possible to differentiate originally dissecting aneurysms from other types of atypical aneurysms.

Patient population

In 13 patients among 585 suffering aneurysmal subarachnoid haemorrhage digital subtraction angiography (DSA) and/or intraoperative view proved the dissecting nature of the aneurysm according to the above given criteria (Table 1). In 6 patients the aneurysm was located on the intradural vertebral artery (VA), in one case bilateral dissecting vertebral aneurysms were present. In 2 patients the basilar artery (BA) was affected, in 3 the internal carotid (ICA), in one the middle cerebral (MCA) and in one the postcommunicating segment (A2) of the anterior cerebral artery (ACA).

A definitive angiographic pearl-and-string sign was seen on all but one affected vertebral artery. In this latter patient, the more proximal segment of the intradural VA was only mildly narrowed and the more distal part was eccentrically dilated. On all VAs with an unequivocal pearl-and-string sign the angiographic dilatation was embraced by a proximal and a distal narrowing of the normal arterial diameter. The angiographic diagnosis at the non-vertebral locations was more problematic. In one of the 2 BA lesions, a false lumen could be identified (case 8, Fig. 3). In the other patient angiography showed a small intimal flap at the base of 7 mm saccular aneurysms distal to the origin of the left anterior inferior cerebellar artery (AICA) (case 7). In this patient surgical exploration after incomplete endovascular obliteration with Gugliemi detachable coils confirmed the suspicion of the dissecting nature.

The dissecting nature of the 3 ICA aneurysms included in this series was also difficult on the basis of angiography alone. In one case close inspection disclosed a false lumen around the relatively narrowed lumen proximal to the origin of the posterior communicating artery (case 10).

Table 1. *Summary of patient characteristics, treatment modality and outcome*

Case #	Location	WFNS grade	Angiographic image	Time and mode of therapy	GOS at 6 months
1	VA	IV	pearl & string	day 3, wrapping	severely disabled
2	VA	V	pearl & string	day 2, wrapping	moderately disabled
3	VA	V	bilateral pearl & string	none	dead (rebleed on day 19)
4	VA	I	pearl	day 5, tangential clip	good
5	VA	V	pearl & string	none	dead
6	VA	I	pearl	day 22, wrapping	good
7	BA	IV	bleb & flap	day 1, GDC coiling, wrapping at 6 months	moderately disabled
8	BA	II	false lumen	day 12 after rebleed, stent + coils	moderately disabled
9	ICA	IV	medial bleb	day 1, wrapping (failed)	dead
10	ICA	IV	false lumen	day 1, wrapping (failed) + bypass	severely disabled
11	ICA	I	bleb	day 8, wrapping	good
12	A2	I	pearl & string	day 13, wrapping	good
13	MCA	II	pearl & string	none	dead (rebleed on day 32)

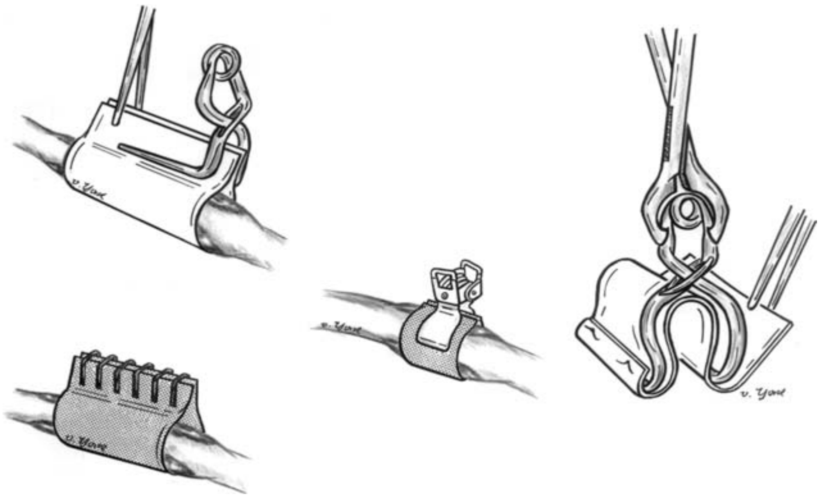


Fig. 1. Wrapping techniques for dissecting aneurysms. (Left) PTFE or Dacron passed under artery and secured. (Centre) Sundt encircling clip. (Right) Fenestrated angled clip to carry wrapping material around artery

In the 2 other cases DSA showed only a blister-like expansion of the medial aspect of the supraclinoid ICA and conclusive diagnosis was possible only during surgery. The only MCA case was identified by a typical pearl and string sign with narrowing of the MCA mainly proximal to the dilatation. In the case of a dissecting A2 aneurysm angiography showed a typical pearl-and-string sign with a proximal dilatation. However, MRA and DSA were primarily misinterpreted as a fusiform aneurysm in combination with arterial spasm, since the studies were performed 12 days after SAH (see Fig. 5). Surgical exploration clarified the dissecting nature.

Surgical methods

In one patient an eccentric dissecting aneurysm could be successfully eliminated by tangential clipping (case 4). This aneurysm located high on the VA looked relatively stable. In general tangential clipping appeared to be a dangerous method for dissecting aneurysms and circumferential wrapping appears preferable. Over time the wrapping techniques were improved (see Fig. 1). In the beginning encircling Dacron-covered metal clips (Sundt type) were used. The disadvantage of these clips is that the diameter cannot be adjusted to the outer diameter of the dissected artery. If the clip diameter is too small the patency of the artery is compromised and if it is too large it cannot stabilize the wall. We believe that the cuff should fit snugly around the aneurysm without constricting it. The purpose of the cuff is only to prevent further expansion. Well fitting cuffs were formed from Dacron or PTFE strips that were pulled through underneath the aneurysm. The ends were then approximated and secured with angled titanium aneurysm clips (Aesculap, Tuttlingen, Germany) or malleable clips. PTFE material is softer than knitted Dacron and appears preferable, since passing a Dacron strip underneath an unstable dissecting aneurysm might result in rupture. Regardless of the material used, pulling the strip of material around the aneurysm requires thorough dissection and removal of clot. In an unstable situation this manoeuvre may be enough to cause rupture. We developed a method that does not require complete dissection. A strip of PTFE is first attached to one blade of a fenestrated angled aneurysm clip. The clip is then passed around the dissected artery. Before releasing the clip, correct length of the PTFE strip is achieved by tension on the free end of the strip (compare Fig. 1).

Endovascular method

Endovascular techniques for dissecting aneurysms were performed in only 2 instances. In one patient standard GDC coiling technique was used for the saccular part of an eccentric mid-basilar aneurysm, resulting in incomplete elimination and further growth later on (case 7). In the other patient (case 8, Fig. 3) a mid-basilar aneurysm was treated by a combination of a coronary Nitinol stent (Cook, Bloomington, IN) and GDC coils (Boston Scientific, Natick, MA) [4, 17, 28, 32].

Results

A summary of the patient and aneurysm characteristics as well as treatment stratification, techniques and results is given in Table 1. Four of the 6 VA dissecting aneurysms underwent surgical exploration between 1 and 22 days after haemorrhage. Two patients were in persistent WFNS grade V and the aneurysms remained untreated. One of these, a 71 year-old man (case 5), died as a consequence of the initial haemorrhage within 3 days after the haemorrhage. The other patient, a 43-year-old man with bilateral VA dissecting aneurysms was admitted in WFNS grade V (case 3). After two weeks the clinical condition improved slowly and he began opening the eyes to verbal stimulation. Surgery was then planned but before it was performed, he suffered a fatal rehaemorrhage on day 19 after the initial bleed. In 3 of the 4 operated cases the aneurysm was wrapped by a variety of methods. In one patient with an eccentric dissecting VA aneurysm, the aneurysm was eliminated by tangential clipping (case 4). After the wrapping and clipping procedures respectively all 4 patients continued to recover from the preoperative state (Fig. 2). No new neurological deficits occurred except transient swallowing difficulties in one patient (case 2).

Both dissecting BA aneurysms were initially treated by endovascular methods. In the first patient a 54-year-old female patient in WFNS grade IV, incomplete packing with GDC coils was achieved (case 7). Follow-up angiography after 6 months showed

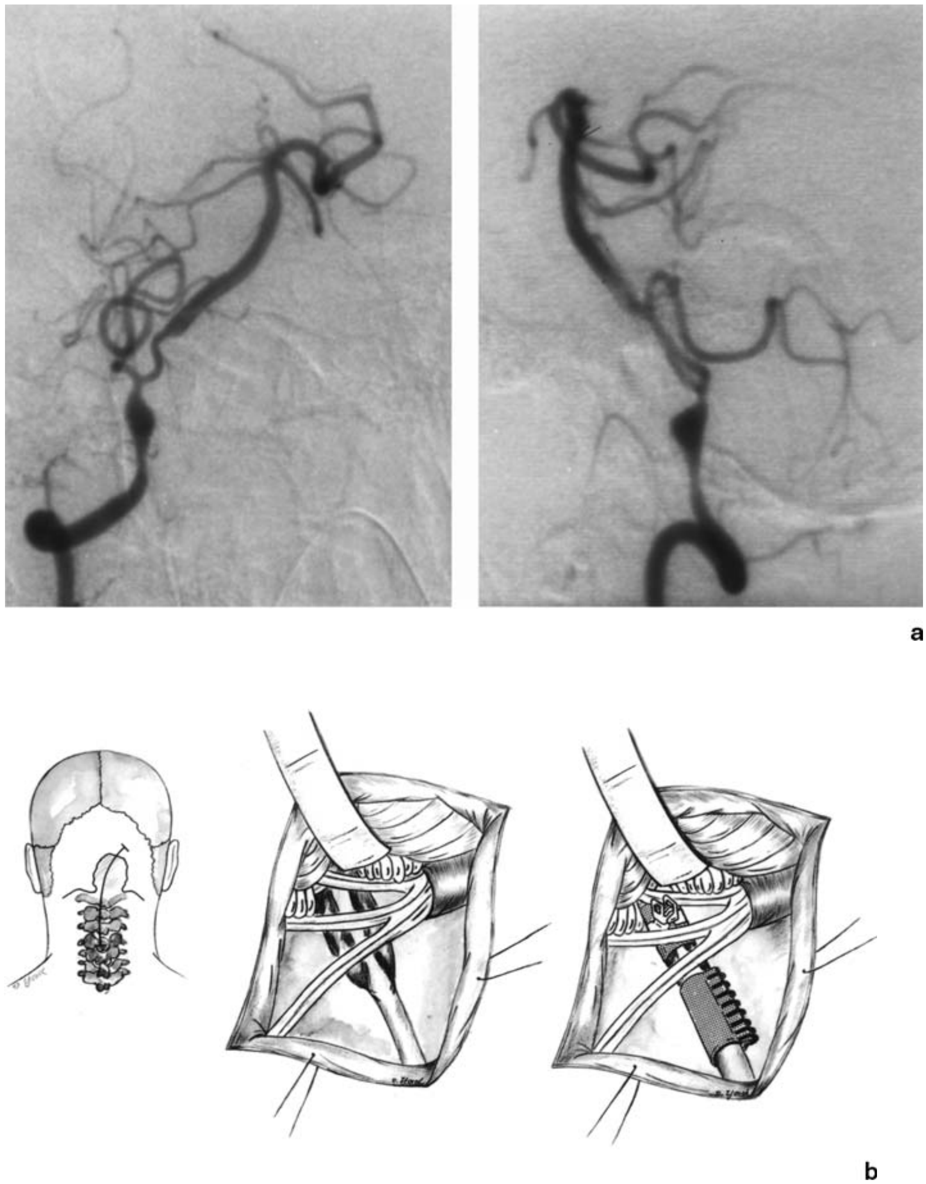


Fig. 2. Illustration of a dissecting VA aneurysm and the surgical technique used (Case 1). (a) Typical "pearl & string" sign on angiography. (b) Drawing of the intraoperative aspect of the relatively extensive dissection and securing the dissected segment with a combination of a clip graft and a Dacron cuff. This combination allowed stabilization of the entire length without trauma to the lower cranial nerves

growth of the aneurysm and coil compaction. The now broad-necked aneurysm was explored by a subtemporal approach and the wrapped with Teflon fibres. Further MRA controls showed a stable size over the follow-up period of 4 years. The other patient (case 8), a 58-year-old man, was initially in WFNS grade II. DSA could clearly identify a false lumen (Fig. 3). He suffered rehaemorrhage 9 days after the initial event and deteriorated to WFNS grade IV. A stable solution was achieved by a combination of a Nitinol stent and GDC coils. The treatment resulted in a small pontine infarction, presumably a result of small vessel occlusion with consequent hemiparesis on the left side. The patient slowly recovered to a GOS 4 at 6 months.

The 3 dissecting ICA aneurysms were all explored surgically. In one of these the diagnosis of a dissecting aneurysm came as an intraoperative surprise. In only one of these 3 cases could ICA continuity be preserved by wrapping (case 11, Fig. 4). This 51-year-old man in WFNS grade I had an uneventful postoperative course. In the other 2 instances, a major portion of the carotid wall disintegrated upon mere touch. One of these patients, a 49-year-old man in WFNS grade IV, died

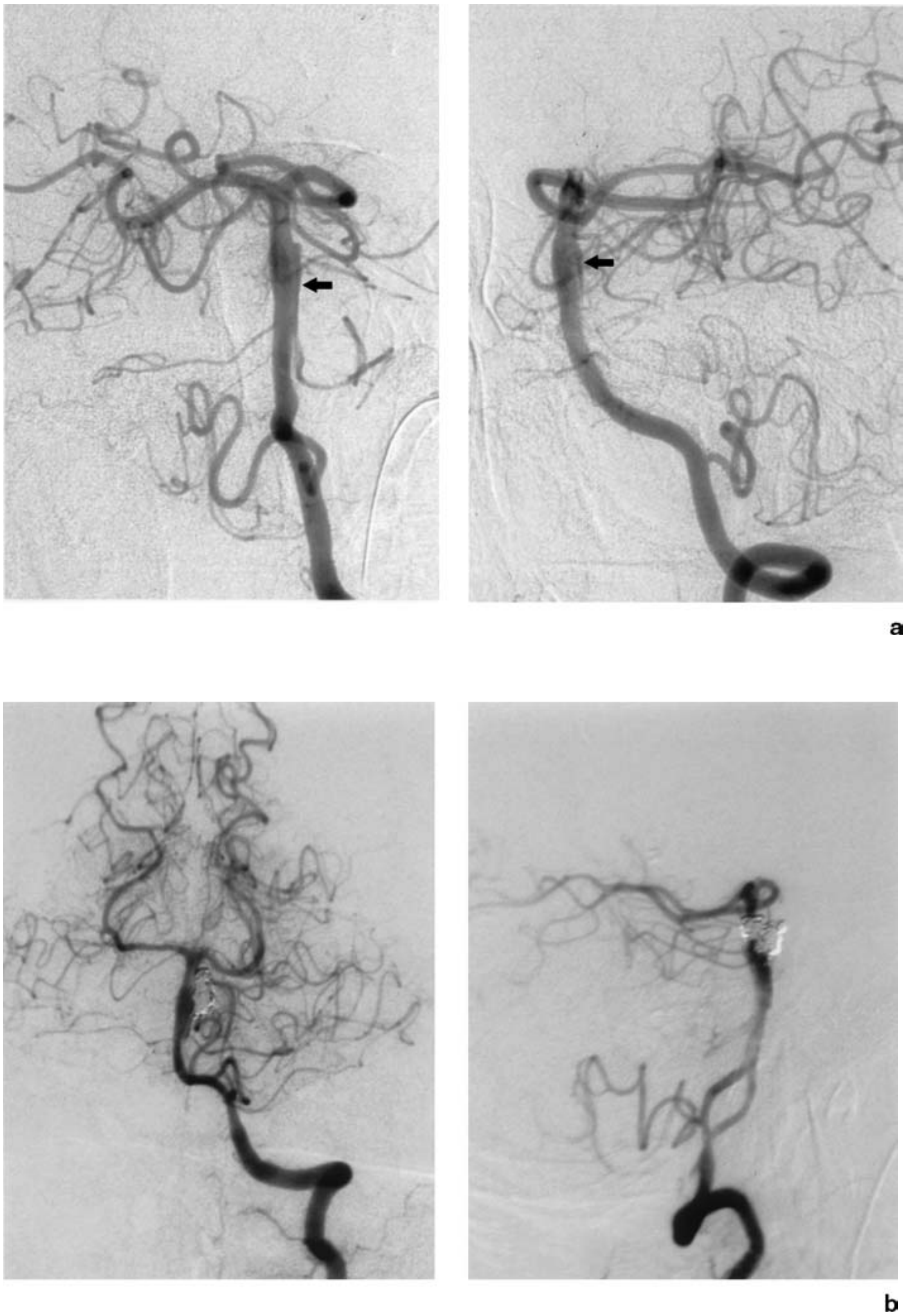


Fig. 3. Illustration of a dissecting BA aneurysm and the endovascular technique used (Case 8). (a) Initial a. -p. and lateral angiography showing a false lumen. (b) Control after combined treatment with a coronary stent and GDC coils. Some coils appear to be outside the initial false lumen, which is due to both initial partial thrombosis and secondary growth of the false lumen

(case 9). The other, a 49-year-old woman in WFNS grade IV, recovered to a GOS 3 (case 10).

The only ACA dissection, an A2 aneurysm in a 45-year-old woman in WFNS grade I, was surgically treated with a Dacron cuff which was limited to the more proximal dilated and perfused segment of the dissection. The postoperative course was uneventful (case 12, Fig. 5).

The only MCA dissecting aneurysm was observed in a 52-year-old woman in an initial WFNS grade II (case 13). Since the dissection was on the M1 segment and neither surgical nor endovascular options could guarantee patency of the lenticulostriate arteries, a decision for a conservative management was taken and control angiography was planned for 6 weeks later. Unfortunately

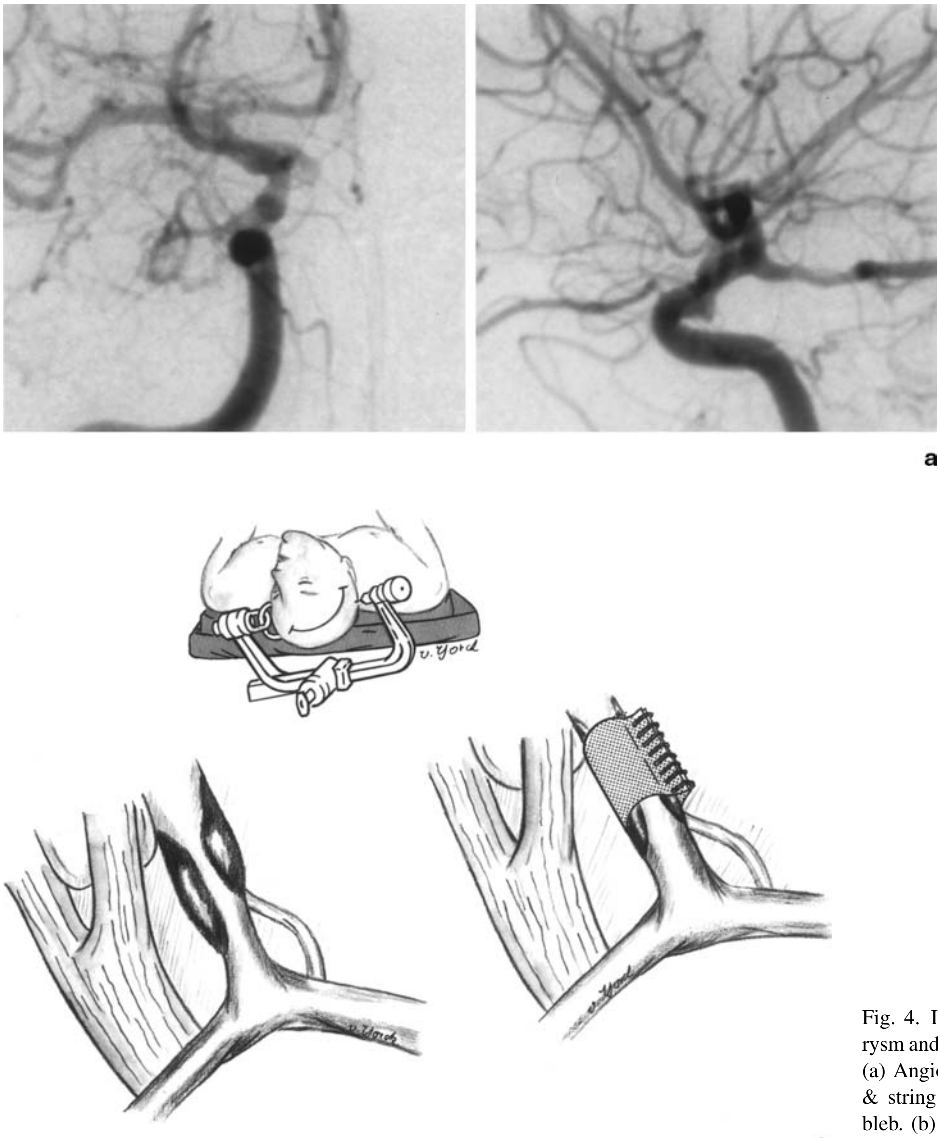
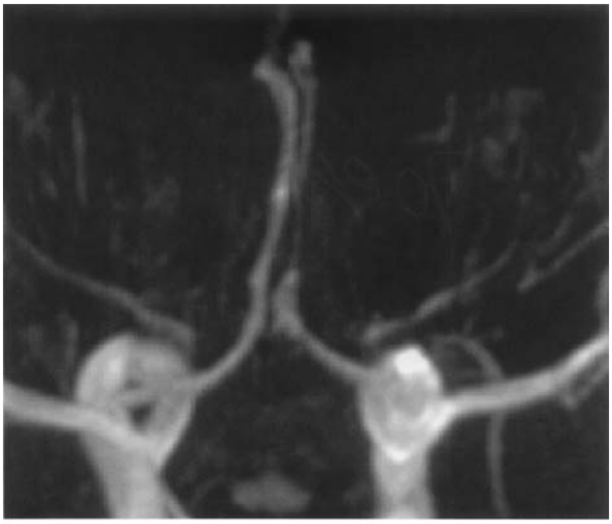


Fig. 4. Illustration of a dissecting ICA aneurysm and the surgical technique used (Case 11). (a) Angiography shows only an atypical pearl & string sign with minimal narrowing and a bleb. (b) Drawing of the intraoperative aspect and surgical procedure used

the patient suffered a fatal rehaemorrhage 4 weeks later at her home.

Discussion

Dissecting intracranial aneurysm as the source of subarachnoid haemorrhage is relatively rare and knowledge with regard to aetiology, natural history and treatment options is scarce. The VA appears to be affected with predilection and the disease appears to be most common among the Japanese population. In the series of Sano and co-workers one third of their vertebral artery aneurysms were of a dissecting nature [55]. The predilection for the intracranial VA may be explained by mechanical considerations, since this arterial segment is exposed to stress by head rotation [29]. The common location on the VA has hindered a more rapid development of treatment options for preserving arterial continuity. Sano and co-workers presented a treatment-oriented classification of dissecting VA aneurysms [55]. The dissecting aneurysms of the vertebral artery were classified into two groups for the purpose of determining a therapeutic approach, namely unilateral and circumferential groups. In the unilateral group, the dissection seemed to involve only one side of the vessel according to the conventional cerebral angiogram. These patients underwent surgical reconstruction of the vertebral artery by direct clipping. In the circumferential group, the dissection was all around the artery. Proximal clipping or trapping was performed in this group. A generous indication for



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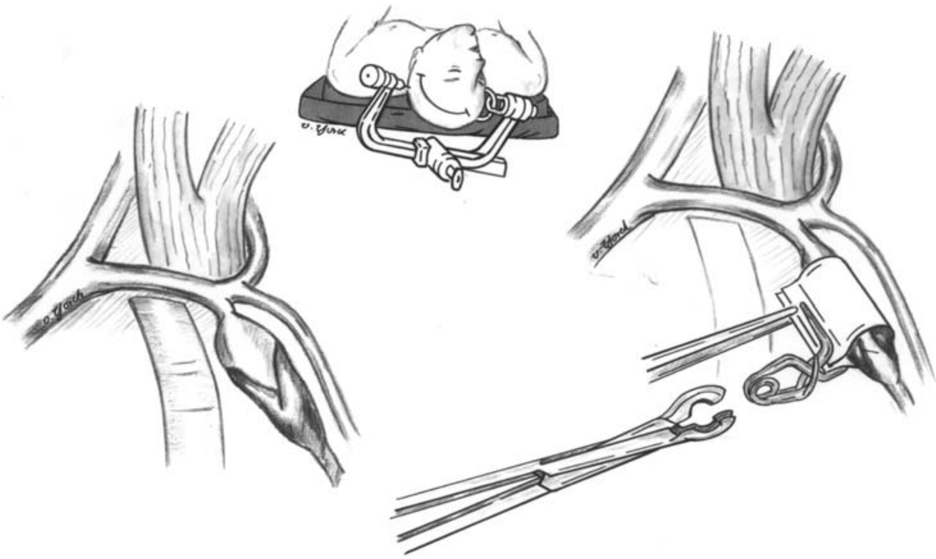

b

Fig. 5. Illustration of a dissecting A2 aneurysm and surgical method (Case 12). (a) MRA shows the typical pearl & string sign. Prior to surgery it was interpreted as a small fusiform aneurysm and additional vasospasm. (b) Drawing of the intraoperative aspect and surgical method. The dissection consisted of a proximal dilatation and a more distal segment with a thrombosed false lumen

surgical and also endovascular procedures sacrificing the VA appears to be generally accepted for dissecting aneurysms located on this artery [19, 21, 23, 30, 31, 38]. The ruptured dissecting aneurysms on other cerebral arteries that are reported with increasing frequency require new assessment of the optimum technique for prevention of rerupture. Although dissecting aneurysms are a rare cause of subarachnoid haemorrhage, based on our series approximately 2%, these difficult problems need a proven management technique for predictable results.

Natural history and classifications of ruptured dissecting aneurysms

In the actual series the aneurysm of 4 patients referred early after SAH was not secured during the first days. Corresponding to the management of saccular aneurysms, we follow a general policy of surgical or endovascular intervention for the ruptured dissecting aneurysms within 72 hours in patients of WFNS grades I–IV. One of the 3 patients (case 5) died as a result of the initial haemorrhage within 3 days. The other 3 not initially secured patients (cases 3, 8, 13) suffered rehaemorrhages after 19, 9, and 32 days respectively, which was fatal in two. These results concur with other reports of an extremely negative prognosis of unsecured ruptured intracranial dissecting aneurysms [9, 36, 42, 45]. In the series of Mizutani and co-workers 29 of 42 patients suffered a rerupture in the unsecured stage [36]. The present evidence does not allow assessing the individual risk of early rehaemorrhage based on angiographic patterns. Only Kitanaka and co-workers suggested that the angiographic picture of ruptured intracranial aneurysms invariably contained a ''pearl'' formation, or a dilated segment in contrast to the unruptured intracranial dissections which commonly present with signs of arterial branch occlusion [21]. We tend to agree with this statement to a large degree but not absolutely. In our experience the ''pearl'' segment was seen on all VA aneurysms but not so invariably at other locations. Particularly on the ICA the angiographic diagnosis of a dissecting aneurysm is very difficult in our experience. Since we have used a high degree of suspicion in cases of unexplained subarachnoid haemorrhage for the last years, we have explored several ICAs, which then turned out to be completely normal. In the acute stage after SAH, MRI does not yet allow the diagnosis of a dissecting aneurysm with certainty [25]. As a result of our negative experience with delayed treatment of dissecting aneurysms it must be suggested that all ruptured dissecting aneurysms should be secured as early as possible.

Several groups have proposed patho-anatomical classifications of intracranial dissecting aneurysms [6, 37–39, 54]. Mizutani proposed a classification of the connection between true and false lumen [38]. Accordingly, the primary mechanism by which a cerebral dissecting aneurysm is created is by the sudden disruption of the internal elastic lamina (IEL). The plane of dissection extends through the media. The majority of aneurysms have one entrance into the pseudolumen (entry-only type). This type is apparently associated with an unstable clinical course. Some cerebral dissecting aneurysms have both an entrance and exit (entry-exit type). This type of aneurysm occasionally contains a constant flow of blood through the pseudolumen and is clinically more stable than entry-only aneurysms.

Technique of securing dissecting VA aneurysms

Trapping the diseased VA segment is the classic method to deal with dissecting VA aneurysms [7, 9, 21, 38, 54]. Although this manoeuvre appears to be well tolerated we prefer to save arterial patency by wrapping techniques, since haemodynamic reserve after trapping might become marginal during the vasospastic phase. One of the 4 patients undergoing repair of a dissecting VA aneurysm had a clear postoperative lower cranial nerve dysfunction, which improved incompletely over a period of 6 months. Damage to the lower cranial nerves appears to be the main problem with the wrapping techniques [21]. Sliding a Sundt type encircling clip is certainly the wrapping method that imposes the smallest amount of mechanical stress onto the lower cranial nerves, but these clips are only useful if an exactly matching diameter is available.

Results of wrapping techniques for saccular aneurysms are generally accepted to be poor [56, 57]. Wrapping dissecting aneurysms differs from wrapping a saccular aneurysm. Our wrapping methods all achieve stabilising the entire aneurysm with a cuff resisting tensile stress in order to eliminate further expansion of the aneurysm. This is usually not possible with unclippable saccular aneurysms and wrapping usually consists of putting patches of cotton or similar material on the aneurysm, possibly in combination with acrylic or fibrin glue. During the follow-up time of up to seven years we did not see any recurrent haemorrhages of treated dissecting aneurysms.

Although not used in the present series for VA endovascular stent based methods are certainly a valid consideration, particularly because the diagnosis of the dissecting nature of the lesion is usually beyond any doubt after DSA [4, 5, 28, 30].

Incidence and special aspects of non-VA dissecting aneurysms

In the present series 7 of the dissecting aneurysms were not located on the VA, 2 on the BA, 3 on the ICA, 1 on MCA and 1 on A2. These locations are all reported in the literature but rare. Reported dissecting BA aneurysms appear to present more often with ischemic symptoms than VA dissecting aneurysms [1, 7, 15, 24, 40, 51, 52, 58, 61, 64]. As in other locations, prognosis appears to be more benign with ischemic symptoms than with SAH. Based on the current evidence it appears that BA dissecting aneurysms presenting with SAH need urgent treatment to prevent rehaemorrhage. However, until recently no appropriate treatment modalities have been available. Our first case was treated primarily with GDC coils only, achieving only temporary stabilization. After surgical exploration and wrapping with Teflon fibres no further growth was detected during a follow-up of 4 years. The other patient was treated after stents became available for this lesion. The stent resulted in complete and permanent elimination of the aneurysm. However, the risk of perforator ischemia is not yet sufficiently defined. Nonetheless, our impression is that stents have resulted in a real breakthrough for the treatment of dissecting aneurysms of the BA [63].

In 3 of our SAH patients dissecting ICA aneurysms were identified as the source. Reports of non-traumatic dissecting ICA aneurysms as a cause of SAH are very rare [35, 47, 59]. These lesions proved to be difficult to identify with certainty prior to surgical exploration. In one of the patients the diagnosis came as an intraoperative surprise. The telltale pearl-and-string feature is discrete at best and the narrowing of the supraclinoid ICA can easily be mistaken for vasospasm. In only one of our cases a double lumen was evident on DSA. The dissected segment extended uniformly for a distance of 5 to 10 mm proximal to the origin of the posterior communicating artery.

Surgical securing of ruptured dissecting ICA aneurysms is problematic [46, 47, 59, 65]. In our cases the wall was usually only stabilized by the surrounding clot and in 2 of the 3 cases the artery ruptured upon mere touch. If this happens the continuity of the artery cannot be re-established. This experience corresponds to the report of Tamano and co-workers [59]. In the setting of acute SAH, occlusion of the ICA appears generally not to be tolerated. Therefore every effort must be made to prevent intraoperative rerupture. We have changed our wrapping methods in recent years. In the beginning we used encircling Sundt type clips or cuffs made from Dacron or PTFE strips respectively which were passed under the artery and closed with malleable clips or angled aneurysm clips. Sundt type clips are a good solution if the size corresponds to the outer diameter of the dissected segment. In general cuffs made from synthetic strips fit better. However, passing underneath the artery requires removal of the clot and can also tear the artery. Dacron appears to be more traumatic than PTFE (Gore-Tex™) since the latter material is softer. More recently we have developed a method that does not require full dissection and passing the material behind the artery. A strip of PTFE is first attached to one blade of a fenestrated angled aneurysm clip. The clip is then applied around the artery so that the strip lies on the artery and is approximated by the blades on the backside. Before releasing the clip, correct length of the PTFE strip is achieved by tension on the free end of the strip (compare Fig. 1). The potential disadvantage of this method is that the clip might obliterate arterial branches, e.g. the posterior communicating artery. This technique is similar to the recently reported method of Yanaka and co-workers [65]. In our series we have not used endovascular stents for dissecting ICA aneurysms although stents have been used for saccular aneurysms and atherostenotic lesions of the supraclinoid ICA. The stent technology is potentially attractive also for this location [33]. A precondition for the endovascular method is that the diagnosis can be made on the basis of preoperative imaging, which was still a problem in our series. The diagnosis of a dissecting aneurysm was an intraoperative surprise in one case, and on the other hand we have explored a number of suspicious carotid arteries after SAH, which turned out to be completely normal arteries.

Since maintaining arterial patency with ruptured dissecting ICA aneurysms is often impossible, the function of the anterior communicating artery should be studied presurgically and in case of insufficient cross flow a high-flow EC-IC-bypass should be installed prior to approaching the ICA.

One of our dissecting aneurysms was located on the A2 segment. There are only few reports of anterior cerebral artery dissecting aneurysms [2, 3, 10, 12, 13, 16, 22, 41, 48, 49, 53, 62, 66]. Hirao and co-workers presented a classification of anterior cerebral artery dissecting aneurysms [14]. Their experience corroborated ours in that these dissections appear to involve extended segments of the artery. The intraoperative view in our case showed a long thickened segment. The more proximal part of the dilatation was reddish corresponding to the "pearl" on angiography and the more distal segment was black since the false lumen was filled with thrombus at that level. On preoperative angiography the dissecting nature of the aneurysm was not clear and vasospasm had been considered. Only the perfused part of the aneurysm was wrapped with a Dacron cuff, because wrapping the entire length would have resulted in the occlusion of several arterial branches. It is certainly a matter of discussion whether wrapping the angiographic pearl alone is sufficient. In this patient the further course was uneventful.

We saw only one patient with a middle cerebral artery dissecting aneurysm. It was treated conservatively. Unfortunately the patient suffered fatal rehaemorrhage 4 weeks after the initial event. In the literature reports of MCA dissecting aneurysms are also rare and there are no established treatment concepts [8, 20, 34, 43, 44, 50]. Our unfavourable experience can only confirm that dissecting aneurysms presenting with SAH have an unfavourable prognosis unless secured by surgical or endovascular methods.

Conclusions

The reported experience suggests that also in Western countries dissecting aneurysms are an occasional source of SAH and the outcome in our conservatively managed patients confirms the poor prognosis of this entity without surgical or endovascular intervention. There are still diagnostic problems with the identification of a dissection in the setting of SAH, particularly at the ICA. MRI does not help with the differential diagnosis in contrast to dissections presenting with ischemic symptoms. Wrapping and endovascular stent based methods can achieve stabilization of the dissected artery without sacrificing the artery. Wrapping and endovascular methods have both specific advantages and limitations. Results of treatment appear to depend largely on the location of the dissecting aneurysm.

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Comment

This is an interesting description of a number of cases of ruptured dissecting aneurysm from a large SAH series. The cases are well described, and there is an extensive literature review as well. Management is discussed at some length, with useful different techniques and their application. The wrapping technique described in Figure 1, where gauze is attached to one blade of a fenestrated clip which is then passed around the aneurysm and tightened as needed, is very useful to minimise dissection, provided there are no significant branches in that segment of vessel. The aim of maintaining patency where possible, particularly for the anterior circulation, is important. The authors make a good point in this regard for dissecting vertebral artery aneurysms, where after SAH the usual custom of occlusion or trapping may lead to ischaemia if vasospasm should develop.

This paper is in accordance with increasing recent awareness that dissecting aneurysms can occur on most intracranial arteries, that the problem is not at all confined to Japan, and that haemorrhage is a common presentation, though less so than ischaemia. As noted, outcome in untreated cases is very poor and specific treatment difficult; developments in endovascular techniques will, one hopes, improve this situation. The difficulty in preoperative recognition of anterior circulation dissections, especially in the ICA, is important, and reminds me of more than one personal case where the artery "fell apart" at an early stage of dissection.

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